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(19)

(54) LIGHT EMITTING MARKER FOR ROADWAY PAVEMENTS FOR TRAFFIC SAFETY

(71) I, LUDWIG EIGENMANN of Swiss Nationality of Vacallo, Canton Tessin, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be described in and by the following statement:—

This invention relates to the art of forming traffic regulating signs or markers on roadways and, more particularly, of providing a roadway with traffic regulating means including light emitting spots capable of positively indicating delineations and other signs on the surface area such pavement.

Traffic regulating engine formed on roadways and forming a part of the traffic-bearing area thereof, such as traffic lane dividing lines, roadway edge defining lines, pedestrian crossing area, and so on, are widely known, and comments are unnecessary about the importance of such signs. The position of such signs on the roadway, their shape and also their colour are prescribed by traffic regulations. The traffic safety largely depends on the fact that such signs are visible to the driver well ahead of the position of the sign.

Various methods have been devised for providing such signs. Conventionally, lane separation and other signs are formed by painting them on the surface of the roadway. Other methods involve pouring and doctoring on said surface layer of settable and suitably pigmented composition. An advantageous method comprises factory manufacturing a tape material adapted to be adhesively secured on the roadway surface and then applying and securing the tape at the desired locations on the roadway. Various procedures and machines have been proposed for expediting the forming of the desired delineation or sign along traffic carrying roadway areas.

Patent literature describes several embodiments of this latter art. U.S.A. Patents Nos. 3,007,838, 3,235,437 and 3,262,375 of the present applicant, are a few examples of such literature relating with applying of preformed roadway marking tape materials for forming the above considered signs.

The prior art has also considered the problems involved with the visibility of the signs, in particular at night and when substantially the sole source of illumination is provided by the vehicle headlamps, that is by a source of light, the rays of which impinge on the marker surface, at spots well ahead of the position of the vehicle, in a direction forming a small or a very small angle with the generally planar surface of the sign. It is known that, the visibility of the sign is provided only by the reflected rays which are reflected back essentially along the path of the incident rays. From the distance at which a part of a sign, on the roadway, could clearly be visible and unmistakably detected by the driver, the position of the source of light (the vehicle headlamps) is very close to that of the driver's eyes. These problems are further aggravated by rainy weather, when a mirror-like film of water forms upon the roadway surface and prevents the required retro-reflection.

In prior U.S.A. Patent No. 3,587,415, also by the present applicant, useful means for consistently solving at least part of the above considered problems have been described. A means for providing retrocollimating elements of improved efficiency has been also taught by the present applicant in his prior U.S.A. Patent No. 3,746,425.

It is further however known that, even by taking advantage of the most suitable and efficient light retroreflecting means, the amount of the light which can be reflected back and actually reach the driver, from a spot sufficiently far ahead is a tiny fraction of one thousandth of that omitted by the source of light on the vehicle. The light travels a distance which is twice the distance between the driver's eyes and the spot in sight. The maximum length of this distance, on which the traffic safety largely

depends, is a function of a lowest useful degree of brilliancy. This important distance will be hereinafter termed "visibility distance" as far as this invention is concerned.

This visibility distance is influenced by the transparency of the atmosphere. In hazy and more particularly in foggy weather this distance is drastically reduced, and the driver can hardly follow the proper path along the traffic lane. This poor visibility is aggravated by the diffusion of light issuing from the vehicle headlamps, because such light is scattered and reflected by the tiny water droplets which form the fog, and a dazzling "white wall" apparently faces the driver. This dazzling light, reflected by the atmosphere, obscures the dim light retroreflected by any retroreflecting means with which the traffic regulating signs on the roadway may be provided.

Light emitting markers are more visible. It is known that sources of light, such as aligned electric or fuel torches are made use of for directing traffic in emergency and in foggy weather. Illuminated traffic buttons and raised bars have been proposed and made use of. Such sources of light cannot however occupy the roadway area, nor can they properly complement the statutory indicia formed on the roadway, nor can they provide non-dazzing guide means which could be safely followed by drivers in poor visibility conditions.

It is therefore an object of this invention to provide a new and useful material which can be associated with a roadway for providing thereon visible traffic regulating signs which are not subject to the above and other limitations and objections, thus considerably improving traffic safety.

According to the present invention a tape structure for use in a roadway surface sign, comprises a composite tape to be superimposed and firmly secured to the roadway surface, a plurality of protrusions distributed lengthwise along the upper face of the composite tape at any of a plurality of predetermined locations thereof, electrically-actuable light sources in said protrusions for signalling said predetermined locations of said protrusions to a user, a pair of elongated strip-shaped leads in said composite tape for electrically connecting said electrically-actuable light source to a supply of electrical energy, and means electrically connecting said electrically-actuable light sources to said leads at any of said plurality of predetermined locations along the direction of elongation of said leads, said connecting means including conductive spikes for puncturing a component of said composite tape and making direct electrical contact with said leads at a selected one of said predetermined locations.

The light sources may be filament lamps, flow discharge lamps, diodes or other light emitting means which radiate light when supplied with electrical energy, i.e. means transducing electrical energy into visible radiation and for which the energy is supplied through the electrical leads, or photoelectroluminescent means, i.e. substances which become luminescent when impinged upon by visible or ultra violet radiation, the energy being provided by the impinging radiation, but only upon excitation by an AC difference of potential supplied through the leads.

The light sources are activated only when weather or other low visibility promoting conditions occur. The composite tape to which such means are associated can itself form part of a sign or marker on the roadway, such as a lane-delineating strip, or alternatively can form no part of the sign, such as at an unmarked segment or interval of a segmented traffic lane dividing line. In such a case, the composite tape is on its upper face of colour equal to or similar to that of the adjacent unmarked area of the roadway.

By providing a composite tape having an upper face of neutral colour (that is of a colour essentially not distinct from that of said not marked areas of the pavement), such tape can be advantageously made use of, according to another feature of the invention, to form an alignment of light spots, to be activated only when necessary, in the middle of the traffic lane, to delineate the proper path to be followed by a vehicle when driven in foggy weather, a row of light sources to be followed by travelling along it proves a great deal more efficient and safer guide than that provided by conventional roadway edge delineations relative to which a vehicle must travel spaced to one side. This special service of a "fog-line" as a guide for the drivers can be discriminated by the colour (such as green or orange) of the selectively emitted light, so that the driver can be aware of following the "fog-line" and not a regular traffic lane edge or dividing line.

A composite tape for the above special service can be advantageously provided with light sources having luminescent substances which emit visible light when electrically energized and simultaneously excited by visible and non-visible light. Use may be made of, for example, pigments such as those sold by the Firm Riedel & De Haën (Hannover, Germany) under the trade names "Orange Red N" or "Grun M5", or by the Firm Chance-Pilkington under the trade names "OB 10 Blue" "OB 14" or "OV 1 Porpora". The vehicles can

be advantageously provided with fog lamps capable of, or filtered for, emitting a powerful beam of nonvisible light, such as U.V. radiations, for exciting such light emitting means. The non-visible light does not cause any dazzling effect in the foggy atmosphere, through which the visible light emitted by the excited pigments is on the contrary visible at the distance of the separation of the illuminated spots which jointly define the safe path to be followed by driving the vehicle above. The composite tape can be made, on its upper face, of a colour distinct either from that of the adjacent unmarked roadway and from that of the regular and statutory markers existing on the same roadway, so that the driver can discriminate between the "fog-line" forming material and the other signs and be made aware of the availability of the means designed to provide him with a guide for driving through the fog.

These and other advantageous features of the invention will be made apparent from the following detailed disclosure of several embodiments thereof, reference being made to the accompanying drawing, wherein:

Figure 1 is a fragmentary perspective diagrammatic view of a roadway provided with a plurality of variously arranged composite tape to exemplify the principal advantages thereof;

Figure 2 is a fragmentary perspective view which illustrates in greater detail a length of one of said tapes;

Figure 3 is a view similar to that of Fig. 2, but in which the components of the tape and of the protrusion and shown by phantom lines so that internal components can be seen;

Figure 4 is a cross-sectional exploded view of the composite tape of Fig. 2; and

Figure 5 is a longitudinal sectional view of a protrusion housing an electrically activated elongated lamp.

In Figs. 1, 2, 4 and 5, numeral 10 generically indicates the surface of a roadway. For simplicity, Fig. 1 illustrates a secondary road for two-way traffic, the roadway area of which is laterally defined by edge delineating continuous lines 12, and provided at its midway with a traffic dividing line 14. Such lines are conventionally identifiable by colour, and according to the regulations usually (edge lines 12 are yellow, and the traffic lane dividing line 14 is white). The view of Fig. 1 is assumed to illustrate a roadway length where overtaking is permitted, if unobstructed by opposite traffic, and this permission is signalled by the fact that the center line 14 is segmented, that is it consists of an alignment of marked lengths spaced by unmarked intervals such as indicated at 14a. For safe driving, a driver should discriminate, well in advance of the vehicle, the edge lines (such as at 12) from the traffic lane dividing lines (such as at 14) and detect whether such lens dividing lines are continuous or segmented (as shown).

When no visibility problems exist, properly coloured and not excessively worn signs on a roadway are clearly visible and identifiable. The invention provides a substantial contribution to the traffic safety under low visibility conditions, and it will now be assumed that all of the above lines would be made according to the invention. This assumption is however not critical for the invention, because a part only of such lines (or of other lines or signs, as explained below) would be improved by applying the principle of same invention.

Any of such lines (or other sign formed on a roadway may be made of a tape structure provided with protrusions at least a part of which is capable, when electrical energy is applied thereto, of emitting visible light focussed into a beam directed towards the vehicles travelling along the roadway lane to which the considered linear marking is adjacent. The light emitting protrusions on traffic regulating markings complement the visibility of such markings, when defective.

Therefore, the said edge delineating markings 12 are complemented with protrusions capable of emitting beams of yellow light directed as indicated by arrows *Lg* while the protrusions associated to the lengths of the center segmented line will emit, when activated by energy, beams of white light beams directed as indicated at *Lb*. In low visibility conditions, the driver will therefore be signalled by light colour whether the path of the vehicle is approaching too near the edge or the center of the roadway.

Further, an inadvertent crossing of the center line 14 and an extremely dangerous approach to the off-side edge of the road might be also signalled by providing protrusions, along the edge delineating tape structure at 12, adapted for emitting, when energy is applied thereto, beams of red light, as indicated at *Lr* which can be seen only when travelling on the wrong side of the road.

When the protrusions are associated with tape structure which form markings on the roadway, such light emitting protrusions are normally arranged on the marking parts of the tape only. For facilitating the laying down of the tape, and for other reasons as explained below, the tape structure can advantageously be uninterrupted and also form, for example, the unmarked intervals 14*a* of a segmented lane dividing line. In such portions the tape is prefabricated so

that its upper face is not clearly distinct, by colour, from the roadway surface 10. The tape structure can be factory prefabricated with upper layers pigmented or otherwise coloured with alternate portions of the prescribed colour and of neutral colour, to form respectively the marking lengths 14 and the intervals 14*a*

An important feature of the invention, therefore, comprises prefabricating a tape structure to be laid on and secured to a roadway pavement, having an upper face of neutral or other colour such that the applied tape does not form part of the traffic regulating sign on the roadway pavement, and providing the same with spaced protrusions capable of emitting light beams of a given colour in a given direction when energy is applied thereto, that is if and when desired or required only.

This provision makes feasible special signalling means, such as the "fog-lines" indicated above. Tape structures of this character are shown at 14*b* in Fig. 1 in phantom lines, to indicate that such tape structures are not actually seen by a driver, in daytime, and generally when the visibility is good, or at least they are distinct from the regular and statutory signalling of the roadway and, therefore, they are not misleading as far as the traffic is concerned. From the point of view of normal traffic regulation, therefore, such lines indicated at 14*b* can be considered as non-existent.

These lines 14*b* are formed on the road surface 10 at the middle of the traffic lanes divided by the segmented marking line 14. The said lines 14*b* are best positioned to define the safest path to be followed by a vehicle which correctly keeps on its own side of the road. These lines 14*b* are formed by a tape structure having protrusions adapted to selectively emit, when energy is applied thereto, light beams of a colour distinct from that of any other signalling means such as green or yellow-green.

When such new signalling means is available (its availability can be in turn signalled by colour, such as green, of the same tape structure, for example), it can be activated solely in foggy weather, for example, and it provides, in such dangerous circumstances a path guide which can be easily and surely followed by the driver, who drives his vehicle straight over and along the alignment of the green (for example) light spots which successively appear ahead to him.

As far as concerns the dimensions and the spacing of the said protrusions, included in the tape structure, such parameters can be widely varied. In general, such protrusion must be of generally convex configuration and of such height from the upper face of the composite tape that no dangerous jerks or vibrations can be induced into an even very fast moving vehicle which travels thereon. The teachings taken from the disclosure in prior U.S.A. Patent No. 3,587,415 can be made use of therefor.

When the light emitting means associated with said protrusion consists of luminescent pigments and substances activated by visible light or U.V. radiations, such pigments or substances can be added to the resinous binder of the aggregate which forms the protrusions of the prior material described in said latter patent literature or in other known manner. How light collimating aggregates can be formed and arranged, and the selection of proper luminescent substances is well known in the art and further details are unnecessary.

In Figs. 2, 3, 4 and 5 preferred modes designed for providing a tape structure having protrusions including electrically excitable or activable light emitting means are shown. The composite tape, when individually considered, is prefabricated by superimposing and integrally joining two layers 22 and 24 of known resin based compositions, such as those described in the above patent literature or, preferably, in my prior Canadian Patent 929,698 (corresponding to French Patent No. 2,097,941). The upper layer 22 is especially designed to provide the desired resistance to traffic wear, and it is suitably pigmented for providing an upper face 20 of the required colour, either having significance in traffic regulation, or having a neutral or distinct colour, in view of the reasons indicated above. The lower layer 24 has for its principal object to provide a firm and permanent bond between the upper layer and the surface 10 of the roadway pavement.

The protrusions 26 (Figs. 2 and 5 provide preferred examples of their configuration) are secured by a known adhesive to the upper face 20 of the composite tape. If desired, the bond can be improved by slightly embedding same in the thickness of the composite tape. Electrical leads are pre-arranged and embedded within the composite tape. Such leads preferably consist of a pair of flexible metal strips 28 arranged, and enclosed, in parallel and spaced relationship between the layers 22 and 24, proper insulation being generally ensured by the fact that the known resin-based compositions of which such traffic regulating signs are usually formed are electrically insulating. If necessary, the said conductive strips 28 can be previously coated with an insulation, such as a known insulating enamel, so that insulation is ensured even if the upper layer 22 is cracked or otherwise damaged by traffic.

In the embodiment of Fig. 3 the electrically activated source of light consists of well known small diodes 30, or glow lamps, having their terminals connected to metallic shaped plates 32 and 34 which are individually connected to the lead strip 28. A preferred mode for providing such a connection comprises securing to the side end portions of said plates sharpened metallic spikes 36, 38, spaced from each other as in the same manner as said strip 28, and forcedly driven through one component of the composite tape to puncture it and engage the strips. The electrically conductive and light emitting components of the protrusion are fully encased and secured within a die cast body of an insulating resin, the said body being at least partially transparent.

The provision of prefabricated protrusions having an upper convex surface and a flat bottom face, from which the said spikes 36, 38 downwardly depend, facilitates both the positioning of the protrusions on an already laid composite tape, and, particularly substitution broken or otherwise uneffective protrusion, during routine maintenance of the roadway.

Preferably, each protrusion comprises a rigid stress and check resistant body including transparent components and nontransparent components, the former components forming a focussing lens system adapted to focus and concentrate the emitted visible light into a flat low beam adjacent to the upper face 20 and therefore to the road surface 10. An indicated in Fig. 2, such beam has a lateral angular width *A* preferably comprised from 5° to 10°, and a vertical angular width Z preferably from 2° to 5°. Limiting the emitted visible light has a twofold advantage: the available light emission is used to its best advantage because it is concentrated in the direction from which the signal is to be seen by drivers, without undue dissipation of energy, and the light cannot be seen from a position different to that occupied by a driver for whom the signal is of interest, to prevent the misleading lights being visible to drivers travelling in other directions or along other lanes, for example. It is important that the vertical elevation of the beam will not exceed 10° (and is preferably less) to prevent dazzling by an illuminated protrusion close to the vehicle.

Fig. 4 illustrates the combination of the essential components of the composite tape. Preferably such composite tape is fully prefabricated prior to bring laid on the road surface 10, which is at its turn preferably prepared by spreading and doctoring thereon a primer layer 40, impervious to water. In some occurrences, such as during repair or maintenance of the road, and when otherwise expedient, the protrusions 26 can be applied upon an already laid and set composite tape, or the same tape can be formed directly upon the road surface 10. In the latter occurrence, the lower layer 24 might also be formed integrally with the primer layer 40, and the lead strips 28 can be fitted thereinto before applying the upper layer 22. This procedure is useful, for example, where the colour of the upper face 20 of the tape, that is the colour (either distinctive or neutral) of the upper layer 12, is to be selected at the very location where the composite tape is to be made use of and set on the roadway.

A protrusion according to the embodiment of Fig. 5, wherein 50 indicates the position of a suitable source of light (a small elongated electric lamp, for example) has a structure comprising an upper armour portion 52, preferably of drawn metal, and transparent symmetrical portions 54, preferably of drawn or die cast resin. This component is designed for emitting oppositely directed light beams of the same colour (such as for center line strips as at 14, Fig. 1) or of different colours, such as is described in the matter of edge delineations 12. The colour of the emitted light is provided by colouring the transparent components 54.

The said transparent components 54 are shaped in cross-section i.e. in vertical planes lengthwise of the composite tape on which the protrusions are transversally arranged, to form part cylindrical lenses for converging and focussing the emitted visible light within the desired vertical angle *Z*. A focusing reflective surface, refractive means or other well known means can also be provided form more efficent focussing of the light and/or for improving the rigidity and/or for ease of mass production and assembly of said components.

WHAT I CLAIM IS:—

1. A tape structure, for use in a roadway surface sign, comprising a composite tape to be superimposed and firmly secured to the roadway surface, a plurality of protrusions distributed lengthwise along the upper face of the composite tape at any of a plurality of predetermined locations thereof, electrically-actuable light sources in said protrusions for signalling said predetermined locations of said protrusions to a user, a pair of elongated strip-shaped leads in said composite tape for electrically connecting said electrically-actuable light sources to a supply of electrical energy, and means electrically connecting said electrically-actuable light sources, to said leads at any of said plurality of predetermined locations along the direction of elongation of said leads, said

connecting means including conductive spikes for puncturing a component of said composite tape and making direct electrical contact with said leads at a selected one of said predetermined locations.

2. The tape structure of claim 1, intended to be positioned on a roadway area in locations coincident with the correct path to be followed by a vehicle along said area, in which, upon applying energy to said light source, there are provided luminous spots in such locations that said correct path can be identified and followed by a vehicle which travels towards and over said luminous spots successively.

3. The tape structure of either of claims 1 and 2, wherein the said light sources are associated in each protrusion with light focusing means confining the emitted light into narrow beams the angular elevation of which above the upper surface of the composite tape is about 3° to 5°.

4. The tape structure of claim 3, wherein said light focusing means comprises a lens system integrally formed in the protrusion.

5. The tape structure of any one of claims 1 to 3, wherein the said light sources comprise a photoelectroluminescent substance capable of emitting visible light when excited by visible radiation and subject to A.C. potential.

6. The tape structure of claim 5, wherein said photoelectroluminescent substance is a substance capable of emitting visible light when excited by ultra violet radiations and subject to an A.C. potential.

7. The tape structure of any one of claims 1 to 6, wherein said electric leads consisting of flexible metal strips are disposed in parallel and in spaced relationship between two components of said composite tape, and wherein said conductive spikes depend from said protrusions at a spacing corresponding to that between said metal strips, said spikes being driven through one of said components until engaging with said metal strips.

8. A tape structure, for use in a roadway surface sign, substantially as described with reference to the accompanying drawings.

For the Applicant
CHATWIN & COMPANY
Chartered Patent Agents
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London WC1X 8QX.

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1469942 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

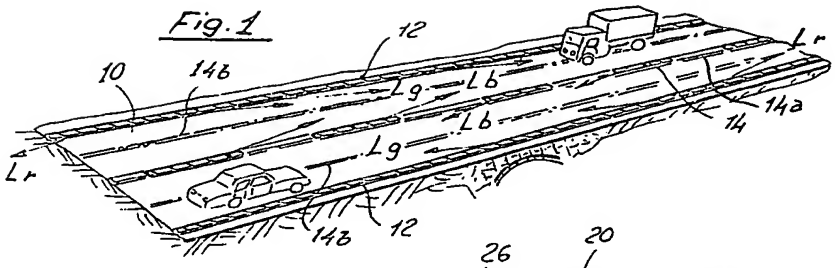


Fig. 2

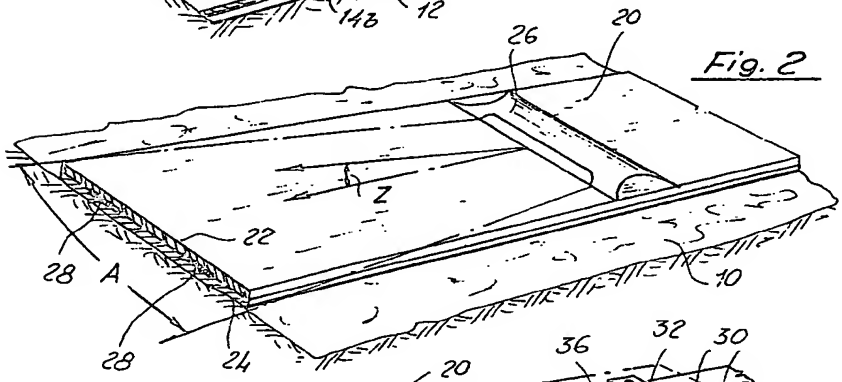


Fig. 3

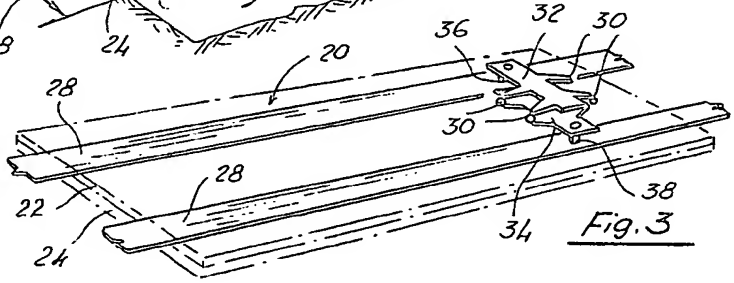


Fig. 4

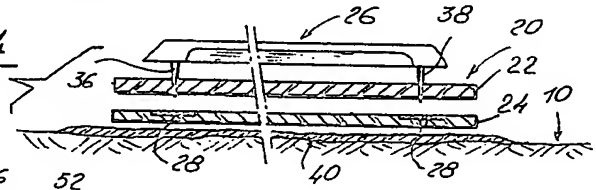
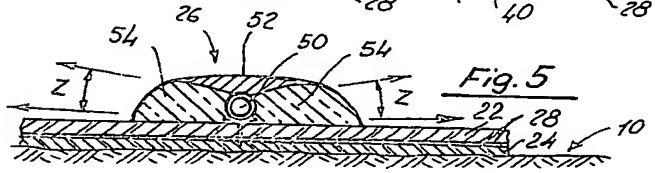


Fig. 5



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